

CLAIMS

What is claimed is:

- 1 1. A pumping system, comprising:
2
3 a submersible, centrifugal pump having an outer housing, a shaft, a
4 plurality of diffusers mounted within the outer housing and a plurality of
5 impellers mounted about the shaft, each impeller having a short hub formed of a
6 moldable plastic and a sleeve axially adjacent the short hub.
- 1 2. The pumping system as recited in claim 1, wherein the sleeve is positioned about
2 the shaft for rotation within a next adjacent diffuser to better withstand abrasive
3 wear relative to the moldable plastic.
- 1 3. The pumping system as recited in claim 2, wherein the sleeve is a metal sleeve.
- 1 4. The pumping system as recited in claim 2, wherein the sleeve is a nickel cast iron
2 sleeve.
- 1 5. The pumping system as recited in claim 1, wherein the moldable plastic
2 comprises an arlene sulfide polymer.
- 1 6. The pumping system as recited in claim 1, wherein the moldable plastic
2 comprises a polyphenylene sulfide (PPS) material.
- 1 7. The pumping system as recited in claim 1, wherein each diffuser comprises a
2 moldable plastic.

- 1 8. The pumping system as recited in claim 7, wherein each diffuser comprises at
2 least one metal reinforcement member molded into the moldable plastic.
1
- 1 9. The pumping system as recited in claim 8, wherein the moldable plastic
2 comprises PPS.
- 1 10. The pumping system as recited in claim 1, wherein each impeller has a plurality
2 of moldable plastic vanes extending from the short hub.
3
- 1 11. An electric submersible pumping system, comprising:
2
3 a submersible motor;
4
5 a motor protector; and
6
7 a submersible pump with a plurality of stages, each stage having an
8 impeller with a plurality of vanes, formed of a moldable plastic, and a sleeve, the
9 sleeve being formed of a material having greater wear resistance than the
10 moldable plastic.
11
- 1 12. The electric submersible pumping system as recited in claim 11, wherein the
2 sleeve is a metal sleeve.
1
- 1 13. The electric submersible pumping system as recited in claim 12, wherein the
2 moldable plastic comprises PPS.
3
- 1 14. The electric submersible pumping system as recited in claim 11, wherein the
2 impeller comprises a short hub formed of the moldable plastic and integrally
3 molded with the plurality of vanes, the sleeve being disposed axially adjacent the
4 short hub.

5

1 15. The electric submersible pumping system as recited in claim 11, wherein each
2 stage has a diffuser comprising a moldable material.

3

1 16. The electric submersible pumping system as recited in claim 15, wherein the
2 moldable material is the same type of moldable plastic used to formed the
3 plurality of vanes.

1

1 17. The electric submersible pumping system as recited in claim 15, wherein the
2 diffuser comprises at least one reinforcement member molded into the moldable
3 material.

1

1 18. A pumping system, comprising:

2

3 a submersible, centrifugal pump having an outer housing, a shaft, a
4 plurality of diffusers mounted within the outer housing and a plurality of
5 impellers mounted about the shaft, each diffuser being formed of a moldable
6 material and a reinforcement member molded into the moldable material.

7

1 19. The pumping system as recited in claim 18, wherein the moldable material
2 comprises PPS.

1 20. The pumping system as recited in claim 18, wherein the reinforcement member is
2 a metal ring having surface features to grip the moldable material.

1

1 21. A method of creating an impeller for a centrifugal, submersible pump having a
2 plurality of stages through which a liquid is pumped, comprising:

3

4 forming a short hub and a plurality of attached impeller vanes from a
5 moldable material; and

6

7

8

9

positioning a wear resistant sleeve axially adjacent the short hub to create a longer hub, the wear resistant sleeve extending into an area more susceptible to wear.

1

2

22. The method as recited in claim 21, wherein forming comprises forming the short hub and the plurality of attached impeller vanes from a moldable plastic.

1

2

23. The method as recited in claim 21, wherein forming comprises forming the short hub and the plurality of attached impeller vanes from PPS.

1

2

24. The method as recited in claim 21, wherein positioning comprises positioning a wear resistant metal sleeve.

1

2

25. The method as recited in claim 21, wherein positioning comprises positioning a wear resistant nickel-resist sleeve.

1

2

26. A method of creating a centrifugal, submersible pump having a plurality of stages through which a liquid is pump, comprising:

3

4

5

6

forming a composite diffuser with a stiffening member integrally molded into a moldable plastic material.

1

2

27. The method as recited in claim 26, further comprising positioning the composite diffuser and an impeller in each stage.

1

2

28. The method as recited in claim 27, creating each impeller from a combination of the moldable plastic material and a wear resistant sleeve.

- 1 29. The method as recited in claim 26, wherein forming comprises forming the
2 diffuser with a stiffening member being a metal ring.
- 1 30. The method as recited in claim 26, wherein forming comprises molding the
2 stiffening member into PPS.
- 1 31. The method as recited in claim 27, further comprising forming the impeller with a
2 short hub and vanes, molded from PPS, and a nickel-resist sleeve adjacent the
3 short hub.
- 1 32. A device for use in a centrifugal pump, comprising:
2
3 a composite diffuser formed of a moldable material and a reinforcement
4 member integrally molded into the moldable material.
- 1 33. The device as recited in claim 32, wherein the moldable material is a moldable
2 plastic material.
- 1 34. The device as recited in claim 33, wherein the reinforcement member comprises a
2 metal material.
- 1 35. The device as recited in claim 32, wherein the reinforcement member comprises a
2 ring having a plurality of gripping features.
- 1 36. The device as recited in claim 32, wherein the reinforcement member comprises a
2 plurality of reinforcement members.
- 1

- 1 37. A device for use in a centrifugal pump, comprising:
2
3 an impeller having a plurality of vanes extending radially from a central
4 section and a sleeve extending axially from the central section to provide a wear
5 surface, the plurality of vanes being formed from a moldable material and the
6 sleeve being formed from a material having greater wear resistance than the
7 moldable material.
- 1 38. The device as recited in claim 37, wherein the moldable material is a moldable
2 plastic.
- 1 39. The device as recited in claim 38, wherein the sleeve is a metal sleeve.
- 1